

NID Application

Benefits Calculation, Monetization, and Resiliency Tab

A.11: Uncertainty Analysis

Uncertainty Analysis

Several sources of uncertainty are considered including water supply impacts due to climate change, changes in water management, projected customer demand uncertainty, and drought. Public benefits that are potentially impacted are recreation and ecosystem. Non-public benefits are potentially impacted are water supply.

Climate Change

The largest source of climate change uncertainty under 2030 and 2070 conditions is the seasonal timing and volume of watershed runoff. Watershed runoff is NID's primary water supply source, followed by reservoir carryover storage. Both of which are potentially impacted by climate change. Public recreation and ecosystem benefits are greatest when reservoirs are at their fullest (see description of recreation and ecosystem benefits under Physical Public Benefits Tab). Drier conditions result in reduced water levels and less public benefits provided by the project. Wetter would provide more public benefits. Public recreation benefits are enhanced when reservoir water levels are higher during the May through September period when recreation demand is highest.

VIC output from bounding scenarios provided by the CWC will be used to simulate various extreme levels of climate change using the HEC-ResSim model described in 'A.1 Project Conditions' within 'Benefit Calculation, Monetization, and Resiliency'. The 2030 and 2070 conditions model runs and historical unimpaired hydrology model input data will be modified using the VIC model output. Monthly ratios will be then produced for each unimpaired hydrology sub-basin relating extreme climate change VIC output to 1995 VIC output. Ratios can be applied as multipliers to the historical daily unimpaired inflow hydrology on a monthly basis for water years 1976 to 2008. These modified inflow time series will be used to simulate With- and Without-project scenarios.

The proposed project is primarily a water supply project intended to supplement NID's available water supply in dry years and in multi-year droughts. It is anticipated that model results will show that the project effectively helps NID manage its available water supply to meet customer demand under a wide range of future hydrologic conditions.

It is anticipated that public benefits will be maintained except for the driest years under the Drier/Extreme Warming (DEW) scenario, when both Rollins and Centennial Reservoirs are both drawn down to their minimum pool water levels.

2070 Drier/Extreme Warming (DEW) Operations Model Results

Rollins Reservoir will benefit from the additional capacity the Centennial Reservoir provides in most years of the DEW simulated period of record (1976-2008), except under the driest conditions. It is believed that the increased Rollins Reservoir storage will provide additional

public recreation benefits under With-project conditions compared to Without-project conditions (Physical Public Benefits Tab, A.2 Recreation Studies). Preliminary indications are that Centennial Reservoir will be able to fill in 20 years out of the 33 year period of record, providing additional carryover storage to better manage for drought conditions, and maximum ecosystem and recreation public benefit (Physical Public Benefits Tab, A.1 Ecosystem Priorities Worksheets).

2070 Wetter/Moderate Warming (WMW) Operations Model Results

Rollins Reservoir will benefit from the additional capacity the Centennial Reservoir provides in all years of the MWM simulated period of record (1976-2008) except for 1977. Increased Rollins Reservoir storage will provide additional public recreation benefits under With-project conditions compared to Without-project conditions (Physical Public Benefits Tab, A.2 Recreation Studies). Preliminary indications are that Centennial Reservoir will be able to fill in 32 years out of the 33 year period of record, providing additional carryover storage to better manage for drought conditions, and consistently providing quality recreation (Physical Public Benefits Tab, A.2 Recreation Studies) and ecosystem (Physical Public Benefits Tab, A.1 Ecosystem Priorities Worksheets) public benefits.

Future Project and Water Management Actions

NID's previous FERC license expired April 30, 2013. NID Yuba-Bear Hydroelectric Project is currently operating on annual licenses until FERC issues a new license. Changes in environmental flow requirements have the largest potential to impact to the Proposed Project. Environmental flow requirements under the old license totaled 7,700 acre-feet per year. Under the new license, environmental flow requirements are expected (based on FERC's Final Environmental Impact Statement) to increase, ranging from a total of 10,200 acre-feet per year to a total of 41,800 acre-feet per year depending on Water Year type. Future environmental flow requirements could be different than what was assumed for this grant application, but are unlikely to change significantly to impact the resiliency of the Proposed Project.

Other Sources of Uncertainty

Customer Demand

The second largest source of uncertainty is projected customer demand. Customer demand is forecast in NID's Raw Water Master Plan (NID, 2011) through 2032. Demand estimates are based on assumptions of population growth rates, land use, and conservation within NID's service area. Projected demands were extrapolated to estimate 2062 customer demand during FERC relicensing of NID's Yuba-Bear hydroelectric project, which were used as the estimated 2070 customer demand. Projected demands include a customer conservation rate of 20% by 2020, as mandated by the 20x2020 Water Conservation Act (SBx7 7).

Customer Demand uncertainty can come from many sources, including:

- Population growth rate
- Land use changes
- State or Federally imposed conservation targets

- State curtailment of Licensed diversions
- “Human Right to Water” water rights modifications
- Expansion of marijuana cultivation resulting from passage of California Proposition 64
- Delta unimpaired flow requirements

The Proposed Project will help NID continue to provide a dependable, quality water supply to its customers into the future acknowledging that there is uncertainty in future customer demand.

Drought

As directed by the CWC’s WSIP Technical Reference (November 2016), a 5-year drought will be analyzed to assess system flexibility and resiliency for 2070 conditions. 2070 conditions are described in ‘A.1 Project Conditions’ within the Benefit Calculation, Monetization, and Resiliency Tab. The driest 5-year period in the modeling period of record is water years 1987 through 1991. The water years selected and water year types are summarized in Table 3. Water year classification is based on the Smartsville Index, also described in ‘A.1 Project Conditions.’ Water Year types based on the Sacramento Valley Index (<http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST>) are also provided for comparison. The Yuba River watershed was slightly wetter in most of these drought years than Northern California as a whole. There weren’t any 5-year periods in the period of record with back-to-back Dry or Critical years according to the Smartsville Index.

Table 3: Summary of water years and water year types for the chosen 5-year drought period (1987-1991).

Water Year	Smartsville Index Water Year Type	Sacramento Valley Index Water Year Type
1986	Wet	Wet
1987	Critically Dry	Dry
1988	Dry	Critically Dry
1989	Above Normal	Dry
1990	Dry	Critically Dry
1991	Dry	Critically Dry

Model results show that under drought conditions the project would still provide public ecosystem benefits of water quality, enhanced wetlands, riparian habitat, native fish habitat, and invasive species management. A cold water pool benefit will be maintained throughout the 5-year drought, assuming a maximum thermocline depth of 30 to 50 feet that occurs in summer and early fall. Annual minimum water-surface elevations typically occur in late spring throughout the 5-year drought, before the thermocline has reached its maximum depth. Ecosystem improvements and benefits would be scaled proportionally with the decrease of reservoir storage and water-surface area below the NMWSE. Given the topographical variances in the Bear River Canyon, decreased water levels during a drought would also likely result in fewer coves available for enhanced wetlands development.

It is believed that the public recreation benefits generated by the proposed project will not be substantially impacted by the drought according preliminary assumptions.

